

## WINDS.

The most frequent directions of the wind during July, 1888, are shown on chart ii by arrows flying with the wind. On the Atlantic coast from Virginia northward the most frequent directions were from southwest to northwest; on the South Atlantic coast, from northeast to southeast; from the west Gulf coast northward to the Missouri Valley from southeast to southwest; in the extreme Northwest, from north to northwest; in the Lake region, upper Mississippi and Ohio valleys, plateau and Pacific coast regions, variable.

## HIGH WINDS.

No maximum velocities of fifty, or more, miles per hour, other than those given in the table of miscellaneous meteorological data have been reported, except at Mount Washington, N. H., where 116 miles per hour from the northwest occurred on the 13th.

## LOCAL STORMS.

**1st. Dakota.**—Fort Meade: a "cloud-burst" is reported to have occurred four miles from this place; creeks and "dry-runs" overflowed, carrying away bridges, barns, and other out-buildings. Brayton, Sully Co.: a violent storm, having some of the characteristics of a tornado, occurred here at 9.30 p. m. The width of its path was about two miles, length six miles. Several buildings were wrecked. **Wisconsin.**—A tornado is reported to have occurred in Kewaunee county, causing damage to dwellings and barns in the towns of Lincoln, Luxembour, and Red River.

**4th. Iowa.**—Cedar Falls, Black Hawk Co.: eighteen buildings, including dwellings and barns, were either partly or entirely demolished in this vicinity by the storm which occurred on this date. Des Moines: a moderate thunder-storm, accompanied by heavy rain, occurred during the evening, and though the storm was not very severe in this city, it is reported to have been very violent northwest and northeast of here. Emmitzburg, Palo Alto Co.: the severe storm of this date unroofed a number of buildings in this vicinity and greatly damaged crops. Reports from Algona, Kossuth Co., state that the storm blew down out-buildings and trees in that county.

**4-5th. Iowa.**—Cromwell, Union Co.: a severe thunder-storm prevailed from 11 p. m., 4th, to 1 a. m., 5th; it was accompanied and followed by heavy rain, 6.50 inches having fallen during the night. Much damage was done to property along the streams in this vicinity.

**5th. New Jersey.**—The New Jersey Weather Chronicle of the State Weather Service, for July, states:

The most destructive thunder-storm of the month occurred on the 5th, when the Pennsylvania Railroad round houses near New Brunswick and a barn near Middlebush were blown down; serious damage occurred in other portions of Middlesex county from wind, hail, and lightning, especially at Middlebush and Milltown. At Asbury Park the new Roman Catholic church was blown down. The destruction to crops was serious and wide spread; whole fields of grain were destroyed.

**New York.**—Albany: an unusually severe rain and hail storm passed over this city between 2.25 and 2.38 p. m., during which time 1.00 inch of rain fell. The wind reached a maximum velocity of forty-five miles per hour, unroofing several houses, and small boats on the river were capsized. **Pennsylvania.**—Scranton, Lackawanna Co.: a severe electrical storm accompanied by very heavy rainfall occurred here in the afternoon. Much damage was done by lightning and heavy rain. The following is from the "Baltimore Sun" of the 6th:

**PHILADELPHIA, July 5.**—The Lackawanna Valley was visited this afternoon by the most furious storm ever known there. Two men and two horses were killed by lightning in Scranton and great damage was done throughout the valley. The rain fell in torrents, while the lightning flashes were sharp, vivid and almost incessant. The streets were flooded with water. At Jermyville and Barbertown hailstones larger than walnuts fell. The fruit trees were stripped of their limbs and leaves, and all growing gardens and crops were totally destroyed.

**6th. Dakota.**—Salem, McCook Co.: a severe wind and hail storm caused considerable damage in the southwestern part of this county. **Minnesota.**—Shakopee, Scott Co.: at 3.45 a. m.

a severe storm passed over this place, causing a large amount of damage to buildings. Reports from Brown and Nicollet counties state that the storm was severe in those counties. **Sleepy Eye, Brown Co.:** a severe storm occurred during the early morning, damaging crops and buildings. **Texas.**—The Signal Service observer at Palestine writes the Chief Signal Officer concerning a shower of pebbles which is reported to have occurred at that place as follows:

PALESTINE, TEX., July 7, 1888.

The CHIEF SIGNAL OFFICER, *Washington City:*

SIR:—I have the honor to transmit a specimen of rock, or pebbles, that fell during the heavy rain storm of the 6th at the residence of Mr. Lacy, about five blocks from this office. The ground for about half an acre was partly covered with the pebbles, the formation of which is not found in this section. Mr. Lacy's family saw the pebbles fall during the rain, and, therefore, there can be no doubt about it.

Very respectfully, your obedient servant,

W. H. PERRY,  
Sergeant, Signal Corps.

NOTE.—The specimens of pebbles submitted range in size from an eighth to one-fourth of an inch in diameter, were of irregular shapes, and resemble in appearance those generally found at the bottom of a brook, or on the sea-shore. C. S. O.

**6th. Wyoming.**—The Cheyenne "Daily Sun" of the 7th states that a very severe and destructive hail storm occurred at Laramie City at about 4 p. m., lasting about thirty minutes. Some of the hail stones are said to have been six inches in diameter. Gardens were destroyed and much window glass broken.

**7th. Indiana.**—Montpelier, Blackford Co.: a violent rain and hail storm passed near here. Small buildings, fences, &c., were levelled, and the corn crop in the path of storm was damaged to a great extent by the hail. **West Virginia.**—Lee, Wirt Co.: a severe hail storm occurred in the afternoon, some of the hail stones being as large as hen's eggs.

**8th. Michigan.**—Edwardsburg, Cass Co.: nearly all buildings at this place were more or less injured by a severe storm which occurred about 11 p. m. **Missouri.**—Kansas City: a very heavy rain storm prevailed between 10 and 11 p. m., causing damage estimated at \$20,000 in the southeastern part of the city. **Ohio.**—Lima, Allen Co.: about 1 a. m. a thunder-storm, accompanied by high wind and hail passed over this place, causing serious injury to the corn crop in neighboring localities. **Mansfield, Richland Co.:** much damage was done to crops east and south of here by the heavy rainfall accompanying the storm of this date. **Virginia.**—Morrisville, Fauquier Co.: a destructive storm swept through a narrow belt of country in the lower part of this county between 9 and 10 p. m. Several buildings were destroyed and other damage done. **Lexington:** a severe wind and rain storm occurred between 10 p. m. and midnight, causing damage to crops. **Wyoming.**—Fort McKinney: large hail, accompanied by very heavy rain, occurred between 2.20 and 3.10 p. m.; crops and telegraph lines suffered serious damage, and several bridges were washed away.

**9th. Illinois.**—Cairo: a severe thunder-storm, accompanied by unusually heavy rain, occurred in the afternoon; the rain fell in torrents for about half an hour and the wind blew at the rate of forty-eight miles per hour, all locomotion in the streets being interrupted during the storm, and several merchants suffered considerable damage from flood. **Virginia.**—The Petersburg "Index-Appeal" states that a violent and destructive hail storm occurred in the afternoon in Chesterfield county, the hail stones being unusually large.

**11th. Massachusetts.**—The Signal Service observer at Boston reports the following:

On the 11th, at 10 p. m., a terrific thunder-storm set in and continued until nearly midnight, when there was a lull which lasted about five minutes, after which the wind suddenly came up and blew with tremendous force, continuing but a few minutes, when it again died away. During the calm, from 12 to 12.05, the barometer fell 0.03 of an inch, and during the gust that followed it rose 0.05. One-fourth of a mile from the place of observation a path was discovered, the breadth of which was from a few rods wide at the western end (in Brighton) to about one-tenth of a mile where the maximum force seems to have been attained. The course was E. 18° N., and the track about two and one-

half miles in length. The path was apparently in a straight line and was marked by trees uprooted or twisted off, prostrated fences and chimneys, unroofed, or otherwise damaged, buildings. A glue factory was entirely demolished, and a part of a rope-walk, weighing several tons, was lifted off its foundation, carried a few feet, and crushed to the ground. Along the path were also frail buildings undisturbed, and flower-pots remaining about on posts, indicating (as several persons mentioned) that the storm did not travel along the surface, but bounded as it went along, touching the ground now and then.

**New York.**—Buffalo: high wind set in at 12.58 and continued until 8.49 p. m., attaining a velocity of forty-eight miles per hour at 5.30. More than fifty vessels were detained in the harbor during the storm. Rochester: a severe storm passed over this city from northwest to southeast in the afternoon, the wind reaching fifty-two miles per hour at 6.55. Oswego: light rain and occasional thunder occurred from 4.26 to 7.10 p. m.; the wind blew in gusts, reaching a maximum velocity of thirty-eight miles per hour, north. This storm was one of the severest of the season, and caused considerable damage to fruit trees and telegraph wires. Oswego Falls, Oswego, Co.: a wind and hail storm in the afternoon caused considerable damage to crops in this vicinity and at Fulton. Ogdensburg, Saint Lawrence Co.: about 5 p. m. a violent wind and hail storm passed through the northern part of this county, doing a large amount of damage. The storm appears to have been most severe about three miles north of Malone, where buildings and trees were blown down. Chateaugay, Franklin Co.: a large amount of damage was done in this vicinity by a severe storm during the evening. Waddington, Saint Lawrence Co.: numerous barns and some dwellings were unroofed in this county. Moira, Franklin Co.: numerous buildings were destroyed by a severe storm on this date. Clyde, Wayne Co.: from 7 to 7.30 p. m. a violent thunder-storm prevailed at this place. Several barns were unroofed and orchards badly damaged. Concerning the storm of this date the following is from the "Malone (N. Y.) Palladium:"

The severest and most destructive storm which has been experienced in northern New York for a third of a century swept through Saint Lawrence and Franklin counties, and on into Clinton and over into Vermont last week (Wednesday evening), its greatest fury being expended along a belt of from one to three or four miles south of the Canadian border. It also extended thirty or forty miles south, but with less of destructiveness. In Malone there was a furious precipitation of large jagged hail just before 6 p. m., and an hour later a gale which broke down many trees and injured crops, particularly hops; but otherwise we escaped injury. Not so, however, was it in Bombay, Fort Covington, Constable, Burke, and Chateaugay, from all of which comes statements of loss and curious effects rivaling those which are told concerning similar visitations in the West.

**15-16th. Kansas.**—The Signal Service observer at Topeka reports:

The hail storm on the night of the 15-16th in Logan and Scott was about three miles wide, and cut all crops in its path to the ground; at Pence it destroyed many glass fronts and badly injured the roof of the bank building.

**17th. Kansas.**—Tribune, Greeley Co.: the rain and hail storm in the afternoon was of great severity. West of this place the rainfall was remarkably heavy and flooded the surrounding country. The hail stones were unusually large and covered the ground along the path of the storm to depths ranging from two to three inches. The Signal Service observer at Topeka, reports:

The hail storm in Greeley and Hamilton on the 17th broke all glass on the west and north sides of buildings in its path, cut all crops to the ground, and killed the birds and grown chickens. Many of the houses in this section are "dugouts," and the heavy rain in this storm filled them up level with the ground. During this storm the temperature fell to 32° in the southern part of Greeley.

**18th. Louisiana.**—Shreveport: several houses were unroofed during the storm which prevailed between 8 and 8.30 p. m.; maximum velocity forty-two miles per hour. **Michigan.**—Cheboygan, Cheboygan Co.: a violent hail and wind storm occurred twelve miles southeast of here, its path being about four miles wide. Hail fell to a depth of two inches. **Pennsylvania.**—Erie: a thunder-storm moving from west to east began at 9.30 and ended at 10.35 p. m.; unusually heavy rain fell during the storm, causing great damage in this city and in the surrounding country.

**19th. West Virginia.**—The tornado observer, Mr. Thomas J. Orr, at Roney's Point, Ohio Co., reports as follows:

This place was visited by the severest rain storm that has ever occurred here; buildings were swept away, fences and crops were totally destroyed, roads were left destitute of bridges, and many lives were lost. The storm occurred in the afternoon, commencing at 5.30 p. m., in the central part of the county, and bearing gradually south until it exhausted its force near the southern line of the county. The clouds were of a light or coppery color, and during the severest part of the storm appeared to have a rotary motion without making any progress. The force of the storm was confined to an area of twenty miles east and west and six miles north and south. The day had been very warm, the thermometer at noon reading 90°, with a sultry atmosphere. The prevailing direction of the wind was west, but the storm appears to have been one of those local ones which gathered and expended its force without traveling in any direction. The duration of the storm was two hours and twenty minutes, and in that time it frequently increased and diminished in violence, but all the time it kept up a constant pour down; the amount of rainfall as observed at several points was about eight inches.

**20th. Dakota.**—Huron: a severe storm of wind, rain, and hail occurred between 7 and 8 p. m., about twelve miles north of Huron. **Vermont.**—East Berkshire, Franklin Co.: a violent storm, apparently a tornado, passed near here, moving in a southeasterly direction. Its path was about one-fourth of a mile wide, within which crops were completely ruined. Hail fell to a depth of five inches in the path of the storm.

**21st. Iowa.**—Dysart, Tama Co.: a very severe hail and rain storm passed eight miles southwest of this place at 7 p. m.; the storm was very destructive from the northwestern part of Grundy county extending forty miles eastward, and its breadth varied from two to six miles. It is reported that the hail-stones were of unusual size, and killed hogs, calves, and smaller animals; trees were entirely stripped of their leaves and much damage was done to the outstanding crops; one school-house was totally demolished and many barns wrecked. The damage is estimated from \$500,000 to \$1,000,000.

**22d. Iowa.**—Waterloo, Black Hawk Co.: a severe and destructive hail storm occurred about sixteen miles south of this place, and also in the vicinity of Reinbeck, Grundy county. **Nevada.**—Winnemucca, Nev.: a "cloud burst" is reported to have occurred twelve miles southwest of station on this date, causing considerable damage.

**23d. Michigan.**—Port Huron: a thunder-storm, accompanied by heavy rain, occurred between 5.20 and 6 p. m.; wind velocity thirty-six miles per hour. A severe hail storm is reported to have occurred in the vicinity of Brockway, twenty miles north of Port Huron. At Brockway Centre and Kenockee, Saint Clair Co., considerable damage was done to crops by a severe hail storm. **Ohio.**—Sandusky: a thunder-storm accompanied by hail and heavy rain prevailed from 2.20 to 4.30 p. m. Considerable damage resulted from this storm to crops in the surrounding country.

**24th.**—**Virginia.**—Dale Enterprise, Rockingham Co.: a destructive hail storm passed one and a half miles north of this place at 1.30 p. m.; hail-stones of unusual size fell in large quantities; garden-vegetables and the standing corn were badly cut.

**25th. Minnesota.**—Moorhead: destructive hail storms accompanied by high wind, occurred to the south and east of this place in the afternoon. Duluth: a severe thunder-storm, accompanied by heavy rain, passed over this city between 2.45 and 9 p. m.; the rain was the heaviest that has occurred here for years and flooded basements, &c. The storm moved from west to east. **Vermont.**—North Enosburg, Franklin Co.: a violent hail storm occurred to the north and east of this place about 4 p. m.; corn and other crops were considerably damaged.

**26-27th. Iowa.**—Denmark, Lee Co.: an unusually heavy rain storm began at 11 p. m., 26th, and ended at 2 p. m., 27th; during that time 4.81 inches of rain fell, most of it in two hours; the surrounding country was flooded.

**28th. Indiana.**—Salem, Washington Co.: the storm in the afternoon was the severest of the season and was accompanied by a brilliant display of lightning; 2.37 inches of rain fell in about an hour, causing considerable damage by washing away fences, etc.

**29th. Illinois.**—Fairmont, Vermillion Co.: a tornado passed near this place in the afternoon, destroying crops, uprooting trees, etc.; its path was about two hundred yards wide.

**30th. Minnesota.**—Saint Paul: a severe thunder-storm, accompanied by heavy rain, occurred between 10.08 and 10.15 a. m., maximum velocity of wind fifty-six miles per hour from the west; two barges on the river were sunk, and trees and chimneys were blown down. Telephone instruments were much injured by lightning.

**31st. Pennsylvania.**—Houser Mill, Monroe Co.: a tornado occurred here about 9 p. m. Buildings were demolished and large trees twisted off. This storm was of remarkable violence, and is considered the most severe ever experienced.

Reports concerning the very heavy rain storms of the 9th and 10th in the upper Ohio valley were considered in the preparation of the matter published elsewhere in this REVIEW under the heading "Floods."

## WATER-SPOUTS.

Pensacola, Fla.: it is reported that a water-spout was observed over the Gulf at 10.55 a. m., 11th; it moved from north-west to southeast and lasted about twenty minutes.

Saint Augustine, Fla., 18th: about 1 p. m., 17th, a large water-spout was observed in the ocean opposite North Beach. At 3 p. m. it crossed the narrow sand spot of North Beach and entered the bay with a terrible rush and ominous roar, churning up the water in a terrible whirlpool. It came directly toward the town, and was much smaller than when first observed. It crossed the town going southwest, and crushed in several buildings; its passage being followed by torrents of rain.—*The (Oswego, N. Y.) Palladium.*

On the evening of the 17th a water-spout burst near Purcell Station on the banks of the river Duckee, Ind., covering the railroad tracks and surrounding country with two feet of water. A passenger train was derailed.

## INLAND NAVIGATION.

## STAGE OF WATER IN RIVERS AND HARBORS.

**Arkansas River.**—Dodge City, Kans., 14th: the water in the river at this place is from one to two feet wide and some inches deep, being the lowest stage of water observed here for many years; the river is entirely dry a few miles below this city.

**Cumberland River.**—Nashville, Tenn., 28th: the navigation of the season is at a stand still on account of low water; the past season has been an unusually short one; a great deal of freight is waiting transportation on the upper Cumberland, which cannot be brought down until after the autumn rise.

**Tennessee River.**—Chattanooga, Tenn.: on account of low water navigation was closed to all vessels on the 28th.

In the following table are shown the danger-points at the various stations, the highest and lowest depths for July, 1888, with the dates of occurrence and the monthly ranges:

Heights of rivers above low-water mark, July, 1888 (in feet and tenths).

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Date.	Height.	Date.	Height.	
Red River:						
Shreveport, La. ....	29.9	8 to 11	20.2	31	14.4	6.8
Arkansas River:						
Fort Smith, Ark. ....	22.0	1	9.0	24	2.5	6.5
Little Rock, Ark. ....	23.0	1	13.1	26, 27	4.3	8.8
Missouri River:						
Kansas City, Mo. ....	24.0	2, 3	20.4	31	12.1	8.3
Omaha, Nebr. ....	18.0	1	16.1	31	9.9	6.2
Leavenworth, Kans. ....	20.0	3	18.2	31	11.7	6.5
Mississippi River:						
Saint Paul, Minn. ....	14.5	1	7.8	30	4.7	3.1
La Crosse, Wis. ....	24.0	1	9.9	31	5.9	4.0
Dubuque, Iowa ....	16.0	1	12.1	31	6.4	5.7
Davenport, Iowa ....	15.0	1	9.5	31	4.5	5.0
Keokuk, Iowa ....	14.0	9, 10	10.1	31	5.1	5.0
Saint Louis, Mo. ....	32.0	1	27.1	31	16.4	10.7
Calo, Ill. ....	40.0	19, 20	28.7	31	17.3	11.4
Memphis, Tenn. ....	34.0	22	23.6	31	15.2	8.4
Vicksburg, Miss. ....	41.0	10, 11	30.0	31	25.5	4.5
New Orleans, La. ....	13.0	1 to 3	10.4	31	8.1	2.3
Ohio River:						
Pittsburg, Pa. ....	22.0	11	22.0	28	1.6	20.4
Cincinnati, Ohio ....	50.0	15	31.5	4	7.4	24.1
Louisville, Ky. ....	25.0	16	11.3	1, 5, 6	4.6	6.7
Cumberland River:						
Nashville, Tenn. ....	40.0	1	13.3	31	2.1	11.2
Tennessee River:						
Chattanooga, Tenn. ....	33.0	1	7.1	29	1.8	5.3
Savannah River:						
Augusta, Ga. ....	32.0	31	9.3	16	6.3	3.5
Willamette River:						
Portland, Oregon ....	.....	1	14.6	31	7.0	7.6

## FLOODS.

A destructive flood, resulting from the heavy rains of the 8th, 9th, and 10th, occurred along the valley of the Monongahela River, and the rivers of western Pennsylvania and West Virginia were swollen into torrents. At Grafton the rise was unprecedented, and the lumber interests suffered severely, the loss to the town and section being estimated at \$250,000. The damage at Rowlesburg was also heavy. Advices from Wheeling, W. Va., state that the freshet was the greatest ever known in that section, and that the destruction to property was beyond computation. The Signal Service observer at Pittsburg reports "that owing to the heavy rains in the Monongahela Valley the Monongahela River rose at the rate of nine inches per hour throughout the day of the 10th, carrying destruction along its shores from the headwaters to the mouth of the river. At points above Pittsburg the river was higher than ever before, reaching forty-three feet at Greensborough, Penn., on the 11th. The damage done by the overflow at Pittsburg during the 10th and 11th is estimated at \$300,000. The river began to fall on the 12th." At Parkersburg, W. Va., the Kanawha River rose thirteen feet on the 10th, washing away one bridge. The following total rainfalls, in inches, from the 8th to the 10th, inclusive, have been reported from stations in Pennsylvania: Pittsburg, 1.60; Uniontown, 2.43; Indiana, 3.56; Somerset, 2.00; Charlesville, 1.56; Huntingdon, 1.62. From the 7th to the 10th the precipitation at Parkersburg, W. Va., amounted to 7.32 inches, and at Columbus, Ohio, 3.24 inches fell during the 8th and 9th. The heavy rains of the 9th and 10th were also very destructive in central and southern Illinois, and in portions of eastern Indiana, causing great damage to crops. A terrific rain storm or cloud-burst occurred at Wheeling, W. Va., on the evening of the 19th. Many lives were lost; houses were wrecked; bridges carried away, and great damage done to property. Reports from all parts of Ohio county, W. Va., indicate that the storm was very disastrous to life and property. At Triadelphia it was particularly severe. Over a considerable part of Belmont county, Ohio, the damage to fruit and crops was very great.

During the afternoon of the 1st a heavy rain storm of short duration visited Deadwood, Dak., and vicinity, causing floods in the gulches and valleys, and doing considerable damage to property, live stock, and crops.

## HIGH TIDE.

Galveston, Tex., 5th.

## ATMOSPHERIC ELECTRICITY.

## THUNDER-STORMS.

From the accompanying table it will be seen that thunder-storms were reported from the largest number (thirty-four) of

states and territories on the 5th, and nearly as many (32) occurred on the 27th and 30th, respectively. They were least extensively reported on the 15th, on which date they occurred